Relative Contributions of Carbohydrates and Proteins to Metal Mobilisation in an Anaerobic Soil Slurry Amended with Rum Vinasse

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The spreading of liquid organic wastes on soils enhances the risks of anaerobiosis and metal mobilisation. Under anaerobiosis, microbial activities drive most of soil geochemical evolutions through reductions, pH changes, net production of mineral and organic ligands that complex metals, and solid alterations/neoformations. Our aim was to identify the main anaerobic processes involved in the mobilisations of Fe, Mn, Cr and Ni on a ferralsol from the Reunion Island, supplied with liquid waste from a rum factory. The study was carried out in batch conditions. Three treatments were performed: (C) soil + water, (+W) soil + waste, and (+W+S) sterilised soil + sterilised waste. During the 40 days of incubation, we recorded (i) partial pressures of gases, (ii) solution concentrations in total carbohydrates and proteins, mineral and organic solutes, total metals and FeII, and (iii) pH and E_H. Carbohydrates and proteins represented 27.8% and 2.5%, respectively, of the dissolved organic carbon in the waste. Proteins were quickly adsorbed and were not detectable in solution after 7 days. Most of carbohydrates, polyols, and small organic acids disappeared during the first 7 days through fermentations and acetogenesis, leading to the production butyrate, propionate and acetate. After 21 days, the acetate was consumed through methanogenesis. The mobilisations of Fe and Mn increased during the first 21 days, and slightly decreased thereafter. In contrast, the mobilisations of Cr and Ni, enhanced by the vinasse supply, did not vary with time; they represent less than 0.1% of the maximum Fe mobilised. The reduction of Fe and Mn would have resulted mainly from the lack of production or the oxidation H_2 produced through fermentations and acetogenesis, and FeII in solution probably represents only a small proportion of total FeII. A geochemical model enabled to assess the effect of variations in mineral and organic ligand concentrations on metal mobilisation.

Key words: *soil; waste; anaerobiosis; microbiology, geochemistry, metal; organic matter; speciation; incubation.*